

STRATEGIC PLAN FOR SUSTAINABLE DEVELOPMENT OF THE GREAT RIVER WATERSHED

JANUARY 2004–DECEMBER 2008



Ridge to Reef Watershed Project

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STRATEGIC PLAN FOR SUSTAINABLE DEVELOPMENT OF THE GREAT RIVER WATERSHED

INITIAL PERIOD, JANUARY 2004–DECEMBER 2008

NEPA



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ACRONYMS

ASSP	Agricultural Support Services Project
CBOs	Community-based organizations
CDCs	Community Development Committees
CDOs	Community Development Officers
EIAs	Environmental impact assessments
FD	Forestry Department
GIS	Geographic information system
GOJ	Government of Jamaica
GRW	Great River Watershed
GRWMC	Great River Watershed Management Committee
IWM	Integrated Watershed Management
NEPA	National Environment and Planning Agency
NGOs	Non-governmental organizations
NIC	National Irrigation Commission
NIWMC	National Integrated Watershed Management Council
NRCA	Natural Resources Conservation Authority
NWA	National Works Agency
NWC	National Water Commission
PDCs	Parish Development Committees
RADA	Rural Agricultural Development Authority
R2RW	Ridge to Reef Watershed Project
SDC	Social Development Commission
SWB	Sustainable Watersheds Branch
UWI	University of the West Indies
WM	Watershed management
WRA	Water Resources Authority

EXECUTIVE SUMMARY

PURPOSE OF THE STRATEGIC PLAN

The *Strategic Plan for Sustainable Development of the Great River Watershed* (hereafter referred to as “the Plan”) is intended to provide a comprehensive framework to guide the actions of many stakeholders to produce outcomes that contribute to achieving three integrated watershed management (WM) goals for the Great River Watershed (GRW).¹ The Plan covers a five-year period (Jan. 2004–Dec. 2008). The Plan² is intended to be a catalyst for building a sense of shared purpose among the residents, landowners, community organizations, Parish governments, and state agencies that have a role in its implementation. The Plan provides a “road map” to develop sustainable watershed management institutions and activities that will survive the transition from support by the USAID-funded Ridge to Reef Watershed (R2RW) Project to routine government programming. The transition road map builds on R2RW to achieve sustainability by internalizing watershed stewardship into attitudes and behavior of residents as well as the procedures and institutional culture of state agencies.

The Plan provides a general description of baseline conditions of the GRW’s natural and human environments as a starting point for further data collection and monitoring. The Plan describes the environmental and economic value of the GRW, identifies problems and issues requiring attention, and proposes actions to address them within the framework of the Action Plan for the Great River Watershed (Section 5.0). Tasks undertaken to implement these actions are to be planned in detail in the annual work plans of state agencies and/or the Great River Watershed Management Committee (GRWMC).

WATERSHED MANAGEMENT

Watershed management has the following interconnected dimensions that must be addressed in WM plans in a holistic manner:

- A *process* of data collection, planning, design, implementation, and monitoring.
- A *system* of land uses and management practices.
- *Tools* for planning and guiding land and water use (tools include laws, incentives, taxes, awareness, stewardship, and technical assistance).
- *Institutional arrangements* that help stakeholders coordinate their WM roles.

INSTITUTIONAL ARRANGEMENTS

Institutional arrangements are the most critical part of the Plan from the viewpoint of sustainability. The institutional structure to implement this Plan must be acceptable to all stakeholders and low-cost in terms of funds and time if it is to survive beyond the R2RW Project. The structure must encourage participation by Parish government and communities as well as state agencies. The design of an institutional structure is constrained by the following factors:

¹This Plan encompasses the Great River Watershed as a hydrological unit rather than the Great River Watershed Management Unit, which includes several gullies that do not drain through the Great River.

²This document is the overall Strategic Plan for the GRW, and includes a five-year Action Plan (Section 5).

- WM law and policy are being revised, and there are currently no guidelines on how institutions should be structured at the watershed level.
- Institutional capacity and authority at the Parish level are evolving, and the ability of the Parish Council to actively participate in WM is currently constrained by a lack of resources and the Council's unclear role in environmental management.
- Parish Development Committees are at an early stage of development, and their roles and capability are evolving.

The main issues to be considered in designing GRW institutional arrangements are the following:

- The need to balance participation of Parish and community stakeholders with that of national level agencies while maintaining technical competence.
- The need to maintain the momentum of the R2RW Project and achieve continuing results with routine state agency budgets.
- The need to involve state agencies and Parish governments from all four GRW Parishes.

The most fundamental institutional challenge is how to design a robust institutional structure to accomplish core WM functions on a sustainable basis. The functions that must be institutionally sustainable into the future are the following:

- Facilitation of communications among stakeholders.
- Advocacy directed at government agencies.
- Raising awareness.
- Mobilization of communities and other stakeholders.
- Facilitation of a means for state agencies to orient their annual programming to support the objectives in this Plan in a manner that complements the programming of other agencies.
- Facilitation of a means for the four GRW Parishes to collaborate on activities and land-use planning in the watershed.
- Implementing a monitoring plan.
- Basic administrative functions, including record keeping and arranging meetings.

Key stakeholders participate in implementing the Plan in the following ways:

- The GRWMC facilitates communication and collaboration among stakeholders.
- The Sustainable Watersheds Branch (SWB) of the National Environment and Planning Agency (NEPA) provides technical and policy support to stakeholders and administrative assistance to the GRWMC.
- State agencies use the Action Plan to guide their activities in the watershed.
- Parish planners use the Zoning Plan to help make land-use and infrastructure siting decisions.
- Teachers, community leaders, and SDC Community Development Officers (CDOs) use the baseline information as a basis for awareness messages.

The proposed functional tasks of the **GRWMC** are:

- Establish and facilitate a Stakeholder Communications Network.

- Convene an annual Inter-Agency Consultative Group meeting.
- Convene quarterly inter-Parish coordination meetings.
- Work with the SWB to coordinate development of a watershed zoning plan with involvement of Parish planners.
- Raise awareness of watershed issues and mobilize communities in collaboration with SDC CDOs.
- Advocate government interventions that will improve human and environmental conditions in the watershed.
- Work with the SWB to monitor implementation of the Plan.

The **SWB** of the **NEPA** is the facilitating state agency for implementing this Plan, and plays a proactive role in building consensus for action. The specific roles of the SWB are to:

- Act as the secretariat of the GRWMC and support its operation through the SWB Field Office in Montego Bay, recognizing that additional resources will be needed to perform this role.
- Provide WM technical advice to GRW stakeholders.
- Facilitate awareness activities.
- Implement the monitoring plan.
- Identify additional watershed issues that should be addressed in the GRW and revise the Plan accordingly.
- Maintain a database of biophysical and socioeconomic data on the GRW, including a GIS.

THE ACTION PLAN

The **Action Plan** portion of the Strategic Plan for Sustainable Development of the GRW covers the five-year period January 2004–December 2008. The Action Plan is built around a framework that links specific actions to strategic objectives and WM goals. The Action Plan employs various planning, technical, and institutional tools to guide and help watershed residents and land owners take actions and adopt behaviors that contribute to achieving strategic objectives, desired outcomes, and, ultimately, WM goals. The **three** Great River WM goals stated below follow the themes of integrated watershed management (IWM): environmental protection, economic development, and stakeholder participation. **Strategic guidelines** provide direction in developing management procedures and allocating resources. **The communication and consultation mechanisms and stakeholder roles** described in Section 4.0 provide the means to implement this Action Plan.

Seven **strategic objectives** contribute to achieving the three WM goals. The objectives are achieved through specific **actions**. Each action is elaborated in the Action Plan in terms of rationale, indicative outputs, responsibilities, resources needed, assumptions, timing, and monitoring indicators. Outputs are produced by one or more stakeholders to accomplish each action. Outputs should be planned in detail on an annual basis either in the operational plans of government agencies or through annual plans of the GRWMC. SWB and the GRWMC must build consensus to ensure that the parties contributing to the accomplishment of an output are

working in a complementary manner. Some tasks may require more than one year to accomplish or may even be continuous over the life of the Plan.

The following Watershed Vision encompasses these statements and is articulated within the IWM paradigm:

Great River Watershed residents have access to sustainable and financially rewarding livelihoods and practice sound watershed stewardship with support from community and government institutions.

The **three Great River WM goals** encompass the three conceptual pillars of the IWM paradigm: environmental protection, sustainable economic development, and stakeholder participation:

1. Improve water quality and environmental conditions.
2. Improve the economic returns from sustainable natural resource use.
3. Actively involve communities, government agencies, and the private sector in WM.

The following **strategic guidelines** provide both a rationale for the selection of management objectives and supporting actions and guidance for implementation.

- Minimize dependence on recurrent financial support and special WM institutions by (1) institutionalizing WM in the procedures, legal mandates, and corporate budgets of government agencies and (2) permanently changing the attitudes and behaviors of individuals, communities, and businesses.
- Integrate planning, implementation, stewardship, advocacy, and livelihood interventions at the community level through participatory methods and community stewardship leaders.
- Make interventions within the appropriate spatial unit: Awareness and stewardship in communities; zoning and water quality monitoring at the watershed level; and integration with land-use and development planning, permitting, and enforcement at the Parish level.
- Use R2RW technical and financial resources to lay the foundation for sustainable WM.
- Consider gender, literacy levels, and socioeconomic status in planning and implementation.

The following **strategic objectives** will be accomplished through a number of actions undertaken by one or more stakeholders:

- *Objective 1: Develop a sound scientific basis for monitoring progress toward achieving WM goals.*
- *Objective 2: Reduce sediment and chemical/biological pollution in the Great River and coastal waters affected by its discharge.*
- *Objective 3: Institutionalize WM in Parish governments and national agencies.*
- *Objective 4: Encourage communities and residents to internalize attitudes and behavior that support WM.*
- *Objective 5: Facilitate sustainable economic development in the GRW.*
- *Objective 6: Develop a collaborative, advocacy-based approach to enforcement.*
- *Objective 7: Establish a sustainable role and configuration for the GRWMC by narrowing its focus and building its capacity.*

1.0 INTRODUCTION

1.1 WHAT IS THE PURPOSE OF THE STRATEGIC PLAN?

The *Strategic Plan for Sustainable Development of the Great River Watershed* (the Plan) is intended to provide a comprehensive framework to guide the actions of many stakeholders to produce outcomes that contribute to achieving three integrated watershed management (IWM) goals for the Great River Watershed (GRW).³ The Plan⁴ is intended to be a catalyst for building a sense of shared purpose among the residents, landowners, community organizations, Parish governments, and state agencies that have a role in its implementation. The Plan provides a “road map” to develop sustainable watershed management (WM) institutions and activities that will survive the transition from support by the USAID-funded Ridge to Reef Watershed (R2RW) Project to routine government programming. The transition road map builds on R2RW to achieve sustainability by internalizing watershed stewardship into attitudes and behavior of residents as well as the procedures and institutional culture of state agencies.

The Plan provides a general description of baseline conditions of the natural and human environments of the GRW as a starting point for further data collection and monitoring. The Plan describes the environmental and economic value of the GRW, identifies problems and issues requiring attention, and proposes actions to address them within the framework of the Action Plan for the Great River Watershed (Section 5). Tasks undertaken to implement these actions are to be planned in detail in the annual work plans of state agencies or the Great River Watershed Management Committee (GRWMC). This means that no additional funding and no special institutions will be necessary.

The Plan covers a five-year period (Jan. 2004–Dec. 2008), but should be reviewed annually and revised as necessary to adjust to changes in laws or the watershed environment and to improve implementation procedures on the basis of lessons learned through implementation. The Plan is intended to be understood by a nontechnical audience while still providing adequate implementation guidance. The Plan is bound in a loose-leaf binder to facilitate periodic revisions/page replacements.

1.2 WHOSE PLAN IS IT ANYWAY?

This Plan belongs to all stakeholders who participate in its implementation. This group includes GRW residents and landowners, community-based organizations (CBOs), Parish governments, state agencies, non-governmental organizations (NGOs), and businesses.

Key stakeholders participate in implementing the Plan in the following ways:

- The GRWMC facilitates communication and collaboration among stakeholders.
- The Sustainable Watersheds Branch (SWB) of the National Environment and Planning Agency (NEPA) provides technical and policy support to stakeholders and administrative assistance to the GRWMC.

³This Plan encompasses the Great River Watershed as a hydrological unit rather than the Great River Watershed Management Unit, which includes several gullies that do not drain through the Great River.

⁴This document is the overall Strategic Plan for the GRW, including a five-year Action Plan (Section 5).

- State agencies use the action plan to guide their activities in the watershed.
- Parish Planners use the Zoning Plan that will be formulated to make land-use and infrastructure siting decisions.
- Teachers, community leaders, and Social Development Commission (SDC) Community Development Officers (CDOs) use the baseline information as a basis for awareness messages.

1.3 WHAT IS WATERSHED MANAGEMENT?

The following definitions provide a basic understanding of the watershed-related concepts used in this Plan.

Watershed	An area of land drained by a river and its tributaries. The word “catchment” is sometimes used interchangeably with watershed, although a catchment is technically the area drained by a single tributary of a river system. Water is the integrating resource in WM because it flows from everywhere in the watershed and its quality reflects land-use and water management practices—from the mountain peaks down to the river mouth. Water carries soil particles (sediment), biological pollutants, and chemicals downstream, affecting the river ecosystem as well as water quality for domestic, agricultural, and commercial purposes. Increased sediment and pollution loads in rivers reduce aquatic biological diversity, increase the cost of treating drinking water, reduce the life of pumps, and kill marine life.
Watershed management	The process of managing land and water within a watershed to produce economic benefits while protecting water quality and maintaining natural river flow patterns and soil productivity. The watershed provides a framework for analyzing and managing human interactions with the environment because water provides a natural medium for monitoring the effects of this interaction. The Government of Jamaica (GOJ) views WM from an ecosystems’ perspective that focuses on natural and human processes and functions and the interactions between them. When watersheds are properly managed, residents and businesses benefit from productive and sustainable land uses, downstream water users benefit from reduced sediment and pollution, and all Jamaican citizens benefit from healthy river and coastal ecosystems. The overall goal of WM is to optimize the balance between the economic productivity of land use in the watershed and the quality of the water flowing in rivers and into groundwater.
Integrated watershed management	An approach intended to pursue water quality and economic development/human welfare goals simultaneously through the planning and implementation of complementary activities by a wide range of government agencies and watershed users. IWM has socio-economic and biophysical dimensions, and relies on a sound basis of laws and responsibilities of government and non-government stakeholders. The GRW can be managed successfully only through the collective actions of thousands of individual landowners and residents working within their communities with assistance from government agencies. The cost of collective action can be minimized through effective communication among all stakeholders and building watershed criteria into the routine procedures of government agencies.
Sustainable development	This Plan is intended to encourage <i>sustainable development</i> in the GRW, meaning that economic development initiatives of the government, the private sector, and individual land owners should maintain the productive capacity of the natural resource base for future generations. Creating a sound financial, institutional, and social basis for WM during the five-year duration of this Plan is an important first step toward achieving long-term environmental and economic sustainability. Sustainable development approaches should be integrated into the activities of all stakeholders.

1.4 WHAT IS WATERSHED PLANNING?

WM plans must be scientifically credible, based on stakeholder input, achievable, and balanced between economic growth and environmental protection. Watershed management has the following interconnected dimensions that must be addressed holistically in WM plans:

- A *process* of data collection, planning, design, implementation, and monitoring.
- A *system* of land uses and management practices.
- *Tools* for planning and guiding land and water use (tools include laws, incentives, taxes, soil and water conservation techniques, awareness, stewardship, and technical assistance).
- *Institutional arrangements* that help stakeholders coordinate their WM roles.

The steps in the WM *process* are the following:

1. Establish a baseline of information on conditions in the watershed relating to the human population and the natural environment, to be maintained and updated by the GRWMC Secretariat.
2. Establish a WM institutional structure.
3. Determine goals and objectives of WM.
4. Analyze trends that are likely to affect WM.
5. Develop a watershed plan.
6. Determine resources needed and available to implement the watershed plan; leverage additional resources as needed.
7. Adopt and implement the watershed plan through annual work plans.
8. Monitor the effectiveness of implementation.
9. Revise and update the plan periodically.

The primary *tools* of WM are the following:

- A watershed plan that includes a Zoning Plan based on WM criteria.
- Land husbandry applied to agricultural lands and lands with forest potential.
- Vegetation strips along river banks and use of trees and permanent vegetation on steep slopes.
- Government review and approval of proposed development activities in accordance with the watershed Zoning Plan.
- Erosion and sediment control, including agricultural lands, construction sites, and road cuts.
- Control of point and non-point sources of pollution, including domestic wastewater, agricultural wastes and chemicals, and hazardous chemicals such as petrol.
- Stormwater best management practices.
- A watershed stewardship program.

Watershed-based zoning is the primary tool for guiding land use toward a sustainable future. A Zoning Plan divides the watershed into zones with various levels of development restrictions based on physical factors such as slope, soil type, geology, and proximity to the river and its tributaries. Existing land use, infrastructure, settlement patterns, and permitting regulations must be taken into account in developing the plan. Special attention must be given in the Zon-

ing Plan to water pollution hazards such as petrol stations and point pollution sources such as industrial facilities, septic systems, and quarries. Non-point sources, such as fields that receive heavy pesticide and fertilizer applications and livestock pastures, must also be considered.

The *pitfalls of watershed planning* are well known from elsewhere in the world and should be avoided while implementing the Plan:

- The plan is a one-time study rather than a long-term management commitment.
- Local ownership and stakeholder involvement in the management process are weak.
- The plan lacks political support.
- The budgets for planning and implementation are insufficient.
- There is too much emphasis on process and tools rather than outcomes.
- The Plan does not adequately integrate existing government programs and regulations into the implementation strategy.
- Plan recommendations are too general.
- There is no legal basis for adopting and implementing the Plan.

I.5 HOW WAS THIS PLAN DEVELOPED?

This Plan was developed by a team comprising a watershed planner and a hydrogeologist working over six weeks in May and June 2003. The team developed the Plan through the following process:

- Reviewed relevant maps and documents prepared by various state agencies and the R2RW Project.
- Visited sites throughout the watershed to assess geology, topography, soil erosion hazard, hydrology, water pollution sources and hazards, land-use practices, and vegetation cover.
- Interviewed residents of the GRW, Parish officials, and state agency officials.
- Held a stakeholder workshop to verify the vision for management of the GRW and prioritize interventions.
- Solicited stakeholder comments on a draft of the Plan.

2.0 BASELINE DESCRIPTION OF THE GREAT RIVER WATERSHED

2.1 PHYSICAL SETTING

2.1.1 Location and Size

The GRW covers an area of 32,725 ha and is located within the Great River Basin, 1 of 26 basins into which the country is divided (see Map 1). The GRW falls within the parishes of St. James, Hanover, Westmoreland, and St. Elizabeth—4 of the 13 Parishes by which the country is administered at the subnational level of government—and contains 3% of the nation's area.

Map 1. The Great River Watershed Basin (WM Unit 3)

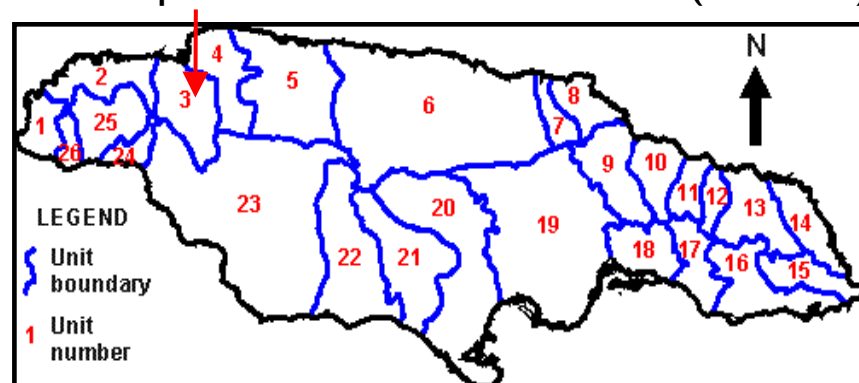


Table 1 shows the distribution of the area among Parishes for the GRW.

Table 1. Distribution of Area among Parishes That Form the GRW

Parishes	Area	
	ha	%
St. Elizabeth	654	2
Westmoreland	7,854	24
Hanover	11,781	36
St. James	12,436	38
Watershed	32,725	100

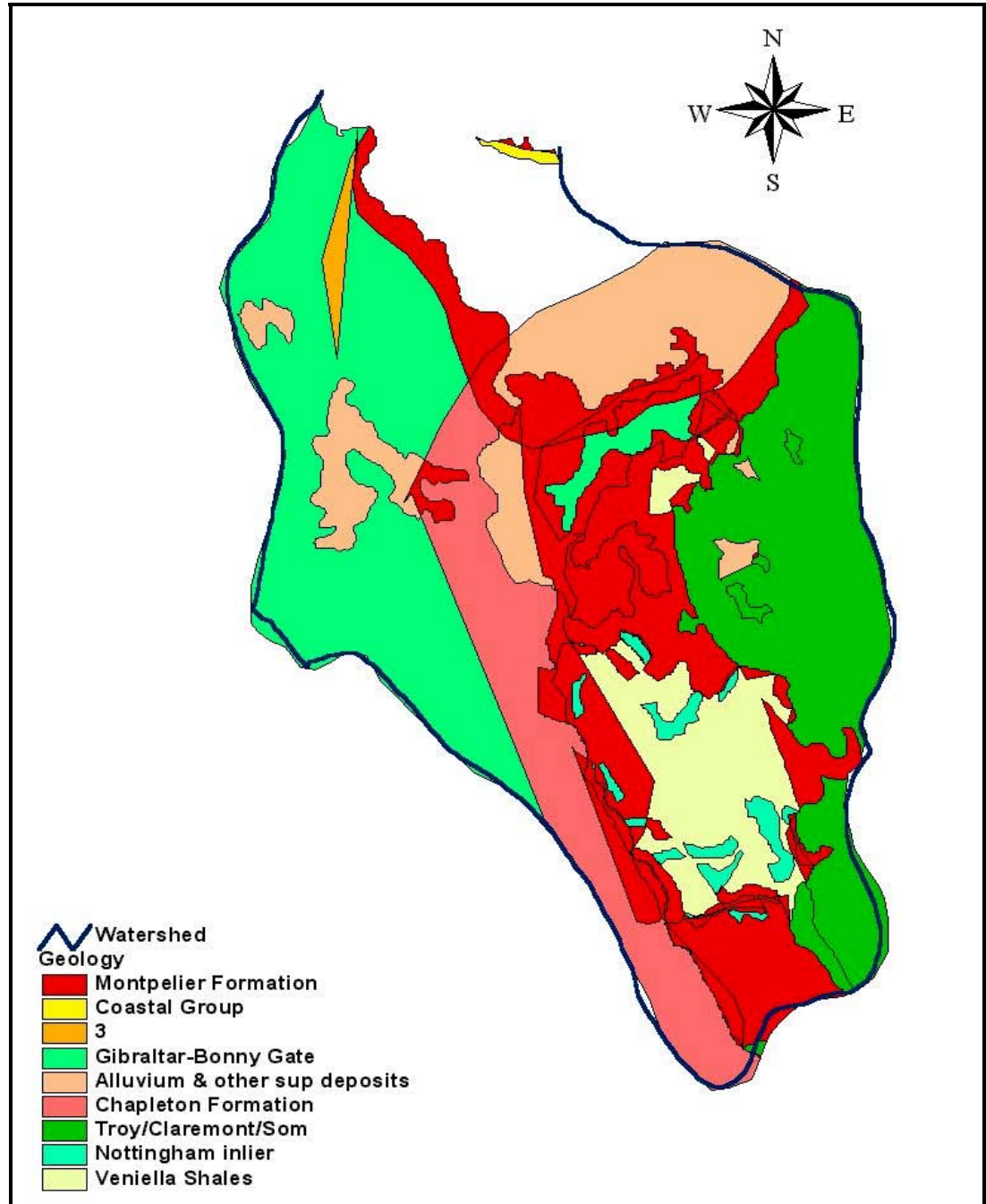
2.1.2 Geology and Hydrostratigraphy

The geology of the GRW, as for the rest of the country, is characterized by rocks of a variety of lithologies (composition and texture) and a complex structure (folds, faults, and fractures) inherited from periods of active tectonism (earth movements such as those caused by earthquakes) during the Cretaceous and Tertiary periods (see Map 2).

The lithology and the structure are important influences on the local hydrostratigraphy—significantly on the distribution of aquifers and aquicludes (shown in Map 3). These terms are defined in the Water Resources Development Master Plan of 1995 as follows:

- Hydrostratigraphy is the property of rocks that determines the occurrence and availability of water in the rocks.
- Aquifers are rock systems with sufficient permeability and storage to support economic, exploitable groundwater yield.
- Aquiclude are rock systems that have low permeability and do not support economic water yield.

Map 2. Geological Formations in the GRW



Map 3. Hydrostratigraphy of the GRW

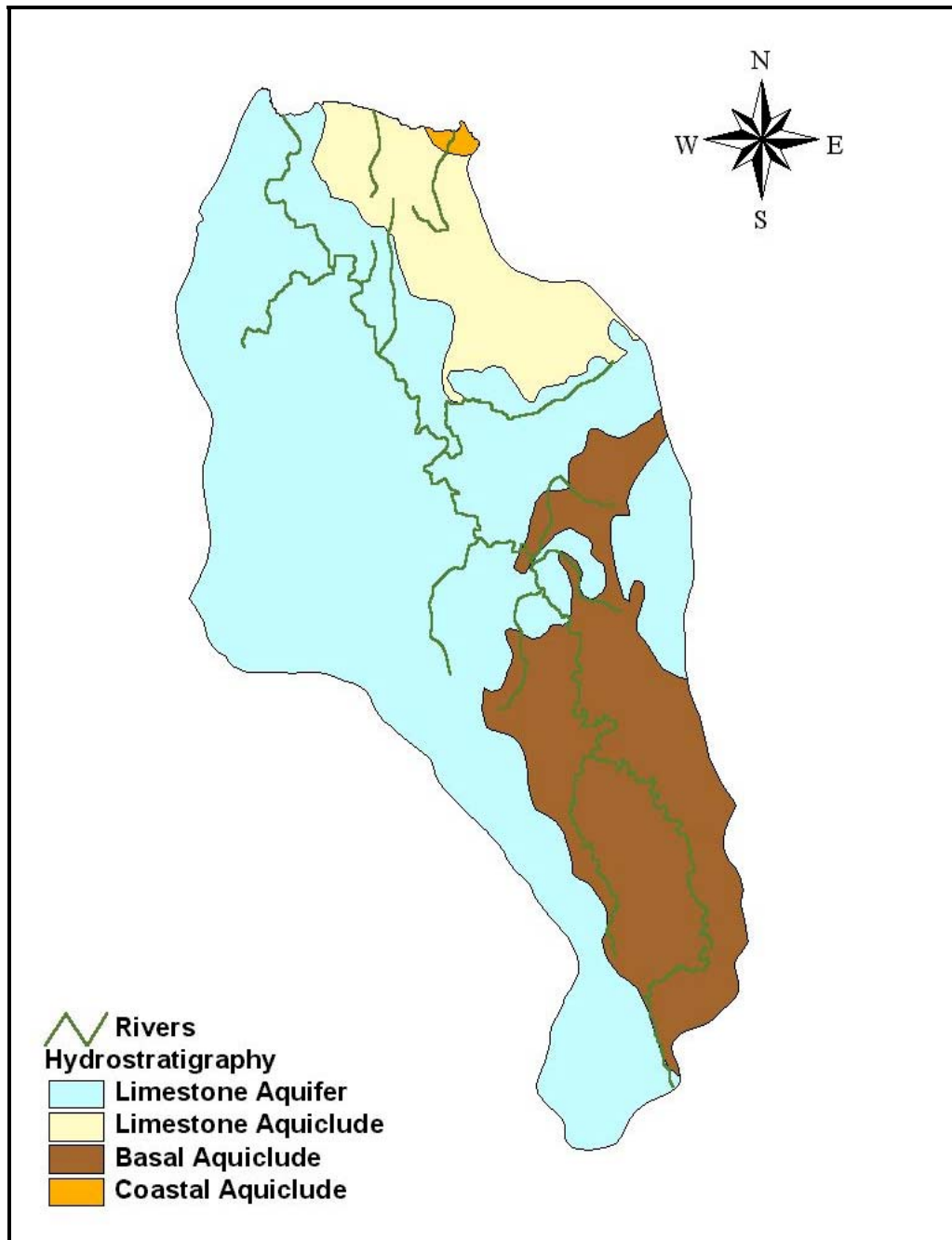


Table 2 summarizes the main rocks that make up the GRW geology. In turn, these rocks are grouped to define the aquifers and aquicludes.

Table 2. Relationship between Hydrostratigraphy and Geology of the GRW

Geological Unit	Dominant Lithology	Hydrostratigraphic Unit (ha)		
		Aquiclude		Aquifer
		Limestone	Non-Limestone	Limestone
Alluvium Group	Clayey loam		6,436	
Coastal Group	Clayey limestone	64		
White Limestone Group				
▪ Montpelier Fm	Marl	751		
▪ Gibraltar-Bonnygate Fm	Karstic limestone			7,502
▪ Troy-Claremont Fm				5,914
Basement				
Yellow Limestone Group				
▪ Chapleton Fm	Clayey limestone		4,816	
▪ Font Hill Fm	Impure limestone		1	
▪ Richmond Fm	Shales		1	
Cretaceous "Group"				
▪ Titanosarcosites Limestone	Impure limestone	48	7,192	
▪ Others				
Total		863	18,446	13,416

The data indicate that, of the total area of 32,725 ha for the watershed, about 56% is composed of rocks that weather readily and produce soils that are highly erodible. About 44% (14,279 ha) is dominated by limestones that exhibit karst features.

The dominant lithologies in the area are the following:

- *Alluvium*: Overlies the white limestone in the middle watershed characterized by low erodibility.
- *White limestone*: The dominant rock in the watershed, especially the lower part, and usually exhibits karst features and shallow soils. Generally low aquifer potential.
- *Cretaceous non-limestone rocks and yellow limestone*: Dominant in the upper watershed, with immature rocks that are easily weathered and highly erodible. These soils are often associated with steep slopes where they should be protected by permanent vegetation to reduce soil erosion and slope failures.

2.1.3 Topography and Drainage

The GRW, like most of Jamaica, has a varied topography. The watershed can be divided into three zones:

- The upper watershed is steep, generally over 20°, and rugged—with a high density of deeply incised gullies, which bequeaths an efficient drainage pattern to these areas. During the rainy season, the gullies are transformed into swift flowing streams. At Pisgah in St. Elizabeth, a spring in one such gully forms the source of the Great River.
- The middle watershed (including the Ramble–Montpelier area) has an undulating topography and more gentle slopes than in the upper watershed, making the drainage less

efficient. During the rainy season, there is a tendency for flooding in the area, especially in the Retrieve and Ramble areas.

- The lower watershed begins at Lethe and runs to the coast. The topography is generally steep and deeply incised. The drainage to the river is very efficient, and the velocity of the river is high.

Table 3 shows the 13 subwatersheds that make up the GRW. The subwatersheds range in size from less than 100 ha to more than 10,000 ha.

Table 3. The GRW's Subwatersheds and Size of Their Land Area

Subwatershed	Size (in ha)
Pisgah	600
Stonehenge	2,650
Lambs River	3,180
To be named	210
To be named	220
Catadupa	2,500
Middle Great River	10,470
To be named	340
Seven Rivers	5,950
Mafoota River	95
To be named	90
Anchovy River	2,930
Lower Great River	3,490
Total	32,725

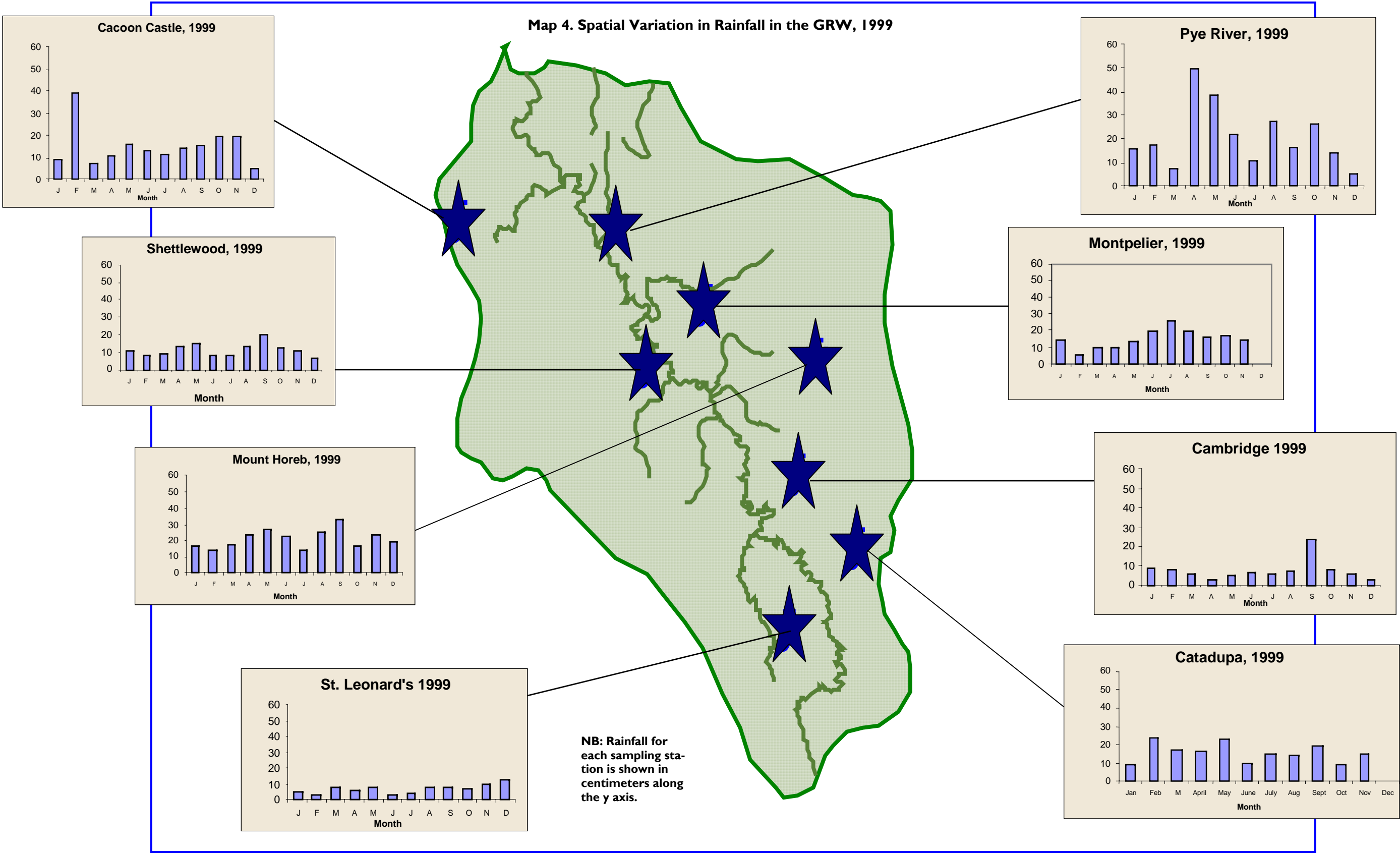
2.1.4 Rainfall

Most of the rainfall received in Jamaica is produced by:

- Upper level troughs that can occur any time during the year.
- Tropical waves and incipient storms that occur mainly in the summer and fall.
- Cold fronts that sometimes become stationary along the north coast of the island.

The annual rainfall has a predominantly bimodal distribution pattern, with a dominant peak from September to October and a secondary peak from May to June. However, intense rainfall may occur in other months, as was the case during Hurricane Charlie in 1951 (August). In addition to this hurricane, years in which rainfall caused major damage in the GRW include 1979, 1986, and 2002.

The National Meteorological Service routinely collects rainfall data. The Hydrometeorological Network covers the island and provides reliable rainfall data for watershed planning and zoning. Map 4, on the following page, shows the distribution of rainfall at various places in the GRW over the months of the year.



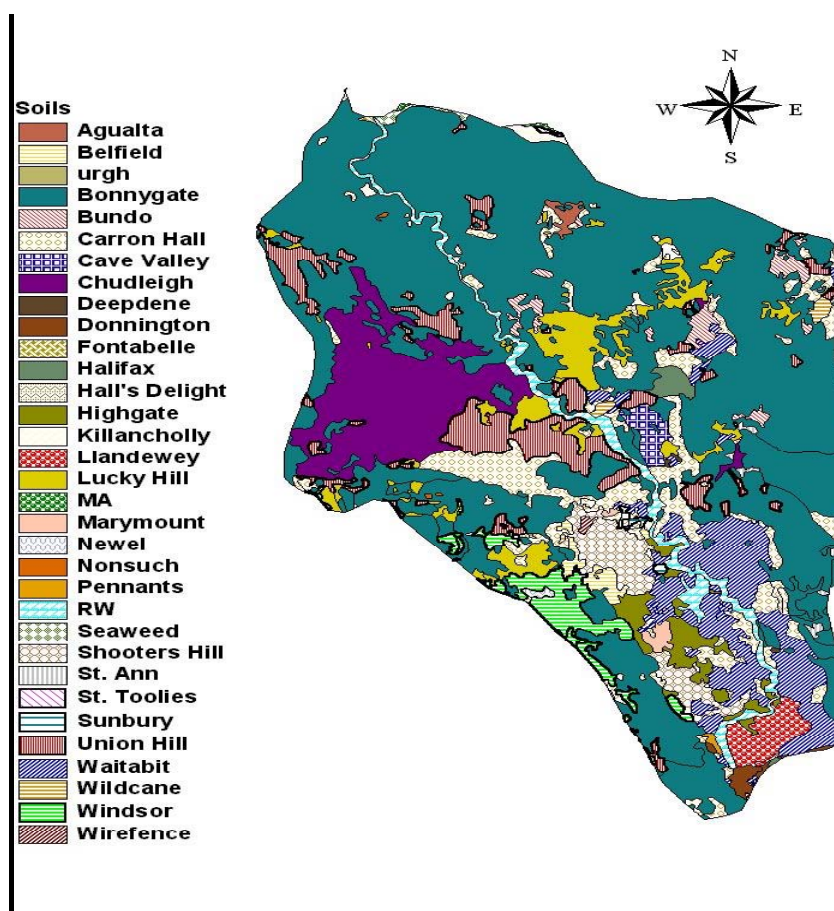
2.1.5 Soils

Map 5 shows the distribution of soil types in the GRW. These various soil types fall within the two general categories described below.

- *Clays* formed from yellow limestone and Cretaceous clastic rocks. These soils tend to weather quickly. Slope steepness affects water retention and the thickness of the saturated zone. In the upper watershed, clays are susceptible to slope failures, especially along road cuts. Slope stabilization structures are needed to protect roads in these areas.
- *Terra rosa soils* form in association with hard limestone and are usually associated with sink holes, cracks, and voids in the rocks. This soil is often mixed with pieces of limestone and is generally very shallow.

Soils are formed through the interaction of the geology, topography, and climate and are one of the most important parameters to be considered in watershed zoning and land-use planning. Soil types vary in the physical and chemical properties that determine erodibility and susceptibility to landslides.

Map 5. Soils of the GRW



2.1.6 Hydrology

The Water Resources Development Master Plan of 1990 divided the island into 10 hydrologic basins and forms the basis for evaluation of its gross hydrologic features. The Great River Basin, of which the GRWMU is one of five subdivisions, is located in the northwest of the country in an area dominated by rugged topography and a dominance of the basement hydrostratigraphic unit. The dominant characteristics of the WMU are:

- High variability in stream flow. This is associated with the rainfall seasons and the rapid concentration of runoff and generally low recharge.
- Low potential to use wells for exploitation of groundwater. Reliance is therefore on springs as the means to use groundwater.

These general features are also true for the GRW. The stream flow data for 2000 (shown in Table 4) for the gauging station at Lethe indicate this high variability—with a low of 1.11 m³/sec recorded during March and a high of 43.08 m³/sec on September 28. In his view of flow data, Greenaway (2004) found that the majority of the flow volume in the Great River occurs over only about 20% of the day on any given year, creating the greatest effect on water quality during those high-flow periods. The WRA flow data from 1996 to 2003 indicate that flows are variable from year to year, with a flow volume of less than 10 m³/sec for 60–70% of most years. Greenaway and his team measured flow volumes at 11 sites throughout the watershed, including upper tributaries, and found that flows in tributaries are generally very low, meaning that water quality in individual tributaries has very little effect on water quality at Lethe. River flow only becomes significant at Hazylymph.

A water balance to elucidate details of the hydrology has not been done, but will be needed for accurate planning within the watershed. This is particularly important since the proportion of limestone that exhibits karst features is high, and needs to be considered in detail to develop an understanding of the hydrology of the watershed.

For a detailed study of the watershed, it will be necessary to supplement the climate data now available from the Hydrological and Meteorological Monitoring Network. One of the basic requirement would be to install a rainfall logger in the watershed.⁵

2.1.7 Water Quality

The University of the West Indies (UWI) conducted a study of water quality in the Great River through sampling and analysis for several chemical and physical parameters at 11 sites along the river and its tributaries (Greenaway 2004). This study was conducted from April 2002 to July 2003 on an approximately monthly basis with funding from the R2RW Project.

The main findings of the study are that water quality in the Great River is generally good, the exception being fecal coliform contamination, which is a problem throughout the watershed and

⁵Cost is £1,100 each; total = £28,600 (= J\$2.6 million at prevailing exchange rate). Met Office to put in place budget line for their maintenance (say, 10% of cost/year).

Table 4. Stream Discharge (m³/sec) in the Great River Watershed at Lethe, 2000

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2.61	1.98	1.44	1.08	1.74	23.19	4.8	9.72	7.2	22.68	7.8	3.63
2	2.67	1.95	1.44	1.08	1.77	18.96	4.53	8.49	7.14	28.35	7.44	3.87
3	2.58	1.95	1.44	1.05	3.66	18.84	4.29	9.06	19.77	20.88	7.2	31.38
4	2.58	1.92	1.38	1.05	4.95	22.32	4.26	8.91	32.13	19.44	6.84	21.24
5	2.43	1.95	1.38	1.05	4.74	17.7	6.57	7.44	20.4	16.89	6.66	31.89
6	2.4	1.98	1.38	1.05	3.54	13.26	9.78	6.66	17.1	15.81	6.42	15.42
7	2.4	1.92	1.38	1.08	4.65	11.43	8.01	6.36	11.43	13.44	6.12	13.95
8	2.4	1.98	1.35	1.05	9	11.43	6.3	5.91	12.45	12.18	5.91	27.9
9	2.37	2.16	1.35	1.11	16.1	10.74	7.08	6.06	11.34	21.42	6.12	16.56
10	2.34	2.7	1.35	1.08	14.3	12.18	8.58	7.44	12.18	29.52	5.94	12.72
11	2.31	2.31	1.2	1.17	16.1	10.8	6.54	16.7	13.53	20.28	5.85	10.89
12	2.28	2.04	1.2	1.38	11.3	9.48	5.64	10.2	12.18	19.2	5.7	9.6
13	2.25	1.89	1.17	1.38	8.49	10.35	5.43	6.6	16.68	17.1	5.37	8.64
14	2.25	1.83	1.14	1.41	8.49	11.76	5.64	5.76	17.55	14.43	5.19	7.86
15	2.22	1.83	1.2	1.35	14	15.3	8.34	5.37	13.62	17.25	4.89	7.32
16	2.13	1.74	1.17	1.38	15.4	16.14	6.54	5.25	26.88	15	4.68	6.84
17	2.1	1.71	1.17	1.71	12.2	16.68	5.58	5.7	22.38	33.3	4.47	6.54
18	2.07	1.68	1.17	1.86	11.5	16.56	5.49	4.68	15.42	39.48	4.38	6.18
19	2.07	1.65	1.17	1.56	8.22	12.81	8.94	4.44	13.08	39.54	4.2	5.85
20	2.13	1.65	1.11	4.8	9.42	10.44	12.9	4.26	11.43	24.45	4.02	6
21	2.07	1.65	1.11	5.07	8.28	9.15	12.1	4.17	10.89	20.64	3.93	6.78
22	2.04	1.65	1.08	6.12	11.4	8.16	10.4	4.05	11.73	21	3.84	5.76
23	2.04	1.59	1.08	4.47	17.9	8.22	9.3	3.84	30.39	15	3.99	5.37
24	2.04	1.59	1.05	2.67	12	8.34	7.38	3.72	30.27	13.44	4.47	5.13
25	2.1	1.56	1.05	1.98	18	6.96	6.72	4.68	28.8	12.36	3.87	5.31
26	2.25	1.53	1.08	1.83	12.8	6.36	7.44	6.72	24.45	11.28	3.93	4.8
27	2.13	1.53	1.11	1.65	12.7	5.91	8.64	4.83	36.09	10.5	4.08	4.59
28	2.07	1.5	1.08	1.56	13.6	5.58	8.43	4.14	43.08	10.05	3.84	4.44
29	2.01	1.47	1.11	1.53	17.6	5.25	14.4	5.76	37.17	9.36	3.66	4.26
30	2.01	n/a	1.08	1.98	31.7	4.95	19.2	8.28	25.05	8.73	3.78	3.99
31	1.98	n/a	1.11	n/a	35.9	n/a	13.4	5.76	n/a	8.28	n/a	4.26
MEAN	2.24	1.82	1.21	1.91	12	11.98	8.15	6.48	19.73	18.75	5.15	9.97

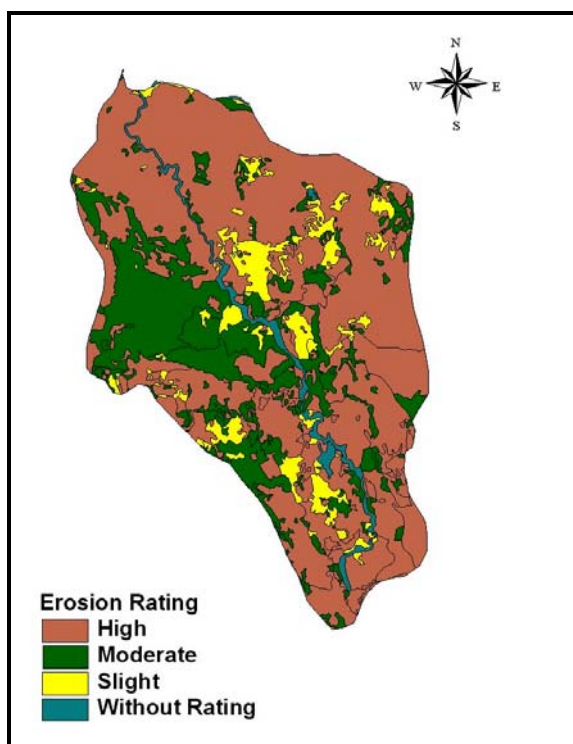
out into the river's estuary into the Great River Bay. The source of this contamination is human and animal fecal waste, but the study was not designed to quantify the relative contribution from various sources. The researchers found that the river's water is well oxygenated, reflecting relatively low levels of nutrient (nitrogen and phosphorous) contamination. Exceptions were in Chesterfield, Marchmont, and Ducketts, where ammonium levels are elevated at all flow levels. During high-flow periods, nitrates are detectable throughout the river system. The river carries a relatively low suspended sediment load except during flood flows, indicating that the rate of soil erosion in the watershed is low. No pesticide contamination was detected in the water samples.

Sampling of water in the Great River Estuary and the marine waters of the Great River Bay indicate that sediment from the river settles quickly when it reaches the ocean, fecal coliform dies off rapidly in salt water, and nutrient contamination is barely detectable. Only during flood flows does the river's sediment plume extend out into the bay.

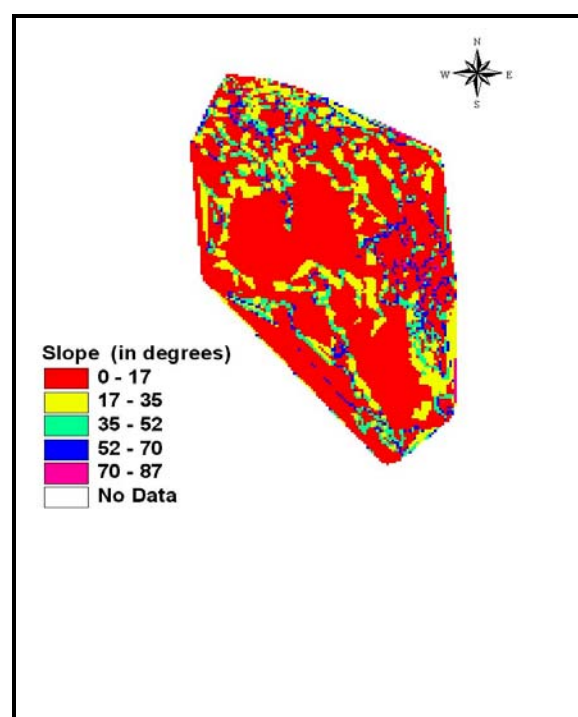
2.1.8 Natural Hazard Potential

Natural phenomena are unpredictable and indiscriminately damaging. They are important because of their frequency, association with loss of life, disruption of socioeconomic activities, and effects on human and natural environments. As shown in Maps 6 and 7, respectively, soil erodibility and slope determine landslide and soil erosion hazard in the GRW.

Map 6. Distribution of Soil Erosion Hazard Intensity in the Great River Watershed (NRCA, 1999)



Map 7. Slope Features in the Great River Watershed, 1999



The primary natural hazards known to occur in the GRW are caused by rain events (e.g., flooding and drought) and soil movements (e.g., landslides and stream bank erosion).

- **Flooding:** Intense rains have historically contributed significantly to flooding across the island. There are two main types of floods: normal⁶ and flash.⁷ Three of the four GRW parishes (St. Elizabeth, Westmoreland, and Hanover) are among the four in Jamaica with the

⁶FEMA defines a *normal flood* as “an abnormally high flow that overflows natural or artificial banks of a stream.”

⁷A *flash flood* is a “flood event where the rising water occurs during, or in a matter of hours after, the associated rainfall.”

least prevalence of flood events. St. James ranks above them but is much lower than Portland Parish, which gets more than twice the number of flood events.⁸

Table 5 lists some factors that need to be considered in assessing risk of flooding in the GRW.

Table 5. Flood and Landslide Risk Assessment Factors in the GRW

Location of Risk	Risk Factors					Risk Level
	Landslides		Flooding			
	Steep Slopes	Unfavorable Geology/Soils	Fast-Moving Water	Overflow of River	Rising Water	
Lower watershed	x		x			Low
Middle watershed		x	x	x	x	Moderate
Upper watershed	x	x	x			High

Flooding is usually attributable (jointly or separately) to three factors:

1. *Fast-moving Water*: This phenomenon is the norm in the upper and middle zones of the GRW where there is rapid runoff in steep gullies. Contribution from other sources such as road storm-water systems and built-up areas is low because the level of urbanization in the GRW is low. Fast-moving water causes significant damage to roads and utility infrastructure (water mains and power lines), especially in the upper watershed area. High-flow volumes also cause high turbidity in the raw water supply of the Great River water supply system.
 2. *River Overflow*: According to local residents, overflow occurs fairly regularly in the Retrieve area in the middle watershed. It normally affects the flood plain or flood fringe as a result of the river being unable to carry high-flow volumes during heavy rains. Homes and other structures in the flood plain and on the fringe are susceptible to flooding.
 3. *Rising Water*: This occurs in limestone karst areas—usually interior valleys, depressions, blocked sinkholes—as the result of poor drainage or rising groundwater. Wetlands and poorly drained flat areas may also be susceptible to flooding by rising water. This type of flooding is experienced in the Ramble area of Hanover.
- **Sediment Movement**: Sediment entering the river system originates through the following physical processes:
 - Soil particles detached from the soil surface by rainfall (surface erosion) and is carried to the river in water flowing across the ground.
 - Soil particles detached from the walls of gullies as they cut into the ground (gully erosion).
 - Landslides (mass soil movements).
 - Scouring of river channels and riverbanks during periods of high water flow.

All of these are natural processes, especially in areas with steep slopes and high rainfall (as is the case in parts of the GRW). Soil permeability and the shape of subwatersheds are also factors that influence the rates at which sediment is produced. Rates of soil erosion can be reduced by maintaining a permanent vegetation cover or by practicing land husbandry in agriculture. Leaf

⁸Portland had 11 damage-causing rainfall events between January 2000 and April 2001.

litter and ground vegetation—not trees—protect the soil surface from erosion. The tree roots do, however, stabilize steep slopes. Erosion in agricultural land hampers productivity over time.

Landslides can be reduced through proper road construction techniques and drainage systems and maintaining tree cover on steep slopes. In the GRW, most of the reported slides were confined to roads on steep slopes. Volcanic rocks are extremely weathered and fractured, resulting in weak rock slopes and elevated risk of slope failures.

Stream bank erosion can be reduced by controlling the amount and velocity of water flowing in the river during high-flow periods and protecting the stream banks with permanent vegetation. Storm flows can be reduced by maintaining vegetation cover throughout the watershed, especially on steep slopes.

After entering the river, sediment can be carried in suspension downstream and out into the ocean or be deposited in the river channel to be detached and moved in subsequent storms. Very intense and prolonged rainfall events, especially if they follow a long period of rain, can move more sediment than is normally moved in a year.

- **Earthquakes** occur periodically in Jamaica and can be quite severe. In addition to destruction of buildings, earthquakes can trigger landslides on steep slopes and cause hillside roads to fail.

2.2 SOCIOECONOMIC SETTING

2.2.1 Historical Basis for Watershed Management

Settlements on unstable hillsides in Jamaica's upper watersheds are rooted in history. After their emancipation from slavery in 1838, the former slaves and the majority of their descendants had little choice but to settle on the steeper slopes with thin, easily eroded soils. The flatter, more arable land in the lower watersheds and coastal plain was retained by the former slave owners and their agents on which to grow sugar cane and raise cattle. Many of these lands in the middle and lower GRW are no longer in agriculture, and an effort is being made to subdivide large tracts for settlement under Operation Pride.

Previous generations of GRW residents and many of the current residents regarded natural resources as inexhaustible gifts; water especially was viewed in this light. Current GRW residents no longer depend as directly on river water as they did in the past, but there is still a sense of connection, especially in communities that are immediately adjacent to the river. Most people, however, do not view the river as an economic resource unless they make their living from it. Other groups have above-average awareness of the river because they live in a place that is subject to flooding or live directly downstream from a pollution source.

Emotional connections are often formed with the Great River tributaries rather than with the watershed as a whole. Residents in some parts of the lower watershed are blocked from accessing the river because the land on both sides is privately owned. Downstream river users sometimes blame upstream residents for actual or perceived pollution. There is an underlying

perception that the continuous flow of the river washes away whatever is placed in it out to the sea, which is viewed as the ultimate open resource.

2.2.2 Socioeconomic Conditions

The population of the GRW is estimated to be approximately 85,000 persons living in small communities and some growing towns. The fastest growing communities in the GRW are Anchovy, Cambridge, Bethel Town, and Ramble. Residents are either employed outside the GRW in the hotel and tourism industries in Montego Bay and Negril, or work within the watershed in agriculture as self-employed farmers or seasonal workers on citrus and coffee farms. Older people tend to remain in agriculture, whereas the young typically travel outside the watershed for employment. The incomes of approximately one third of GRW households is considered to be below the official poverty level, and unemployment levels are high, especially among young people. Approximately one half of the households are headed by women.

All GRW communities are served by primary schools, and all children have access to secondary schools, although in some cases quite far from their homes. A significant proportion of adults are either illiterate or semiliterate.

Land tenure is an issue in the GRW, and it is common for households not to have clear legal title to their land. These households cannot use their homes as collateral for loans and may have difficulty substantiating their land claims. The Department of Lands is working to issue titles to legitimate landowners.

2.2.3 Community Institutions

The communities in the GRW are like others in rural Jamaica in that the key community institutions are churches, schools, and women's and youth groups. Ministers, teachers, large landowners, and well-educated people are generally the community leaders and are most likely to take leadership roles in watershed stewardship. People who make a living from the river, such as raftsmen, are also potential stewardship leaders because of their economic dependence on high-quality water. Engaging young people is critical, and the 4H Club is an excellent vehicle because of its emphasis on agriculture and environment.

The means of communication, the institutional channel, and the message are key factors in reaching people in the GRW and convincing them to change their behavior. People with limited literacy rely on community leaders for information, and most information is passed verbally. The opinions of older and higher status people carry more weight; therefore, a participatory approach is needed to ensure that illiterate and low-status people are included in participatory planning.

2.2.4 Local Government

The governments of the four Parishes that have lands within the GRW must work collaboratively to address WM issues meaningfully. Achieving collaboration is currently difficult because:

- The role of Parish government with respect to environmental management is not clear.

- The role of the Parish Council versus the Parish Development Council (PDC) with respect to environmental matters is not clear.
- Limited resources and information.
- Limited experience working collaboratively with other Parishes on environmental management issues.

These constraints will be partially overcome when the roles of Parish governments and institutions become clearer as decentralization progresses. Parish governments will be technically better able to participate in WM as Parish planners are provided with necessary planning skills and tools. The overall problem of inter-Parish coordination in WM would be eliminated if the boundaries of Parishes and watersheds were made coincident.

2.2.5 Infrastructure

Road Network: The GRW has a network of all-weather roads that provides good access to all communities. This network facilitates the delivery of services and the marketing of goods produced in the watershed.

Road maintenance costs are closely linked to geology. Roads constructed on steep hillsides are affected by landslides, whereas those in the flood plain are inundated during overflow floods. Inadequate drainage often leads to road failure in steep terrain. Since many of the other types of infrastructure (water mains, electric light poles, telephone lines, etc.) depend heavily on the road network, their vulnerability increases during flood events. The downtime in production from blocked and damaged roadways has not been measured. However, the cost to the country in terms of rehabilitation works and loss in production is significant.

The construction of Highway 2000 in the watershed in the latter part of this decade will bring much more road traffic into the GRW and may result in more feeder roads being built as communities and businesses grow along the highway corridor.

Water Use and Supply: 43.1% of GRW households have piped water supplied by small National Water Commission (NWC) treatment systems scattered throughout the watershed. Sparsely populated areas in the upper watershed are not served by NWC systems and must rely on springs or rainwater harvesting for household needs. River water is used by some residents for household purposes such as bathing and washing clothes, for recreational purposes such as swimming and fishing, and for commercial purposes such as rafting and irrigation. The National Irrigation Commission (NIC) is developing a 32-ha irrigation system at Seven Rivers in collaboration with a local farmer's group.

The Great River supplies most of the water for Montego Bay through an intake near the mouth of the river. The NWC Regional Office in Montego Bay reports that, during heavy rains, water off-take is reduced due to heavier sediment loads in the water and that there is also potential damage to the distribution system.

2.2.6 Sanitation and Environmental Public Health

Sanitation and environmental public health are generally good in the GRW, considering that many households do not have access to piped water, sewage disposal systems, or solid waste pick-up service. The following public health problem areas require attention by communities and the government:

- Poor drainage during storms results in the mixing of runoff with effluent from latrines, septic tanks, and sewers, making residents vulnerable to waterborne diseases caused by bacteria, viruses, and protozoa. The warm and humid conditions that normally prevail after a rainfall event are conducive to the growth of pathogens. Contagious diseases such as typhoid and Dengue Fever have been reported in the watershed.
- Most households have some form of human fecal waste disposal system in the form of pit latrines or water-flushed systems, but there are some households that have neither. Assistance is needed to create and manage household pits, as evidenced by the high levels of fecal coliform concentrations in the river.
- Most solid waste is disposed of by burning, but some is thrown into gullies or the river itself. Gullies and drains are often blocked by garbage, accelerating erosion and causing public health problems.
- Some farmers use agrochemicals in an unsafe manner, creating health risks for themselves, their neighbors, and downstream residents. They need to use protective clothing and apply best practices on the use and disposal of agrochemicals.

2.3 ECONOMIC DEVELOPMENT IN THE GREAT RIVER WATERSHED

2.3.1 Agriculture and Forestry

Agriculture. Most farmers in the GRW have relatively small-holdings of 1–2 ha, although there are some large commercial agriculture businesses such as the Montpelier Citrus Company and several large livestock operations. As is the case in most other parts of Jamaica, the amount of land in production has declined over the past decade as well as productivity per hectare. The GRW used to be a big producer of Scotch bonnet pepper, but Jamaica has lost market share to Costa Rica in recent years. There are underlying socioeconomic reasons for the decline in agriculture, but farmers clearly need more technical and marketing support to become competitive. Land tenure is also a problem because farmers who do not have legal title cannot use their land as collateral for loans.

The immediate goal of agricultural improvement is to produce basic food crops to achieve self-sufficiency in food. Home gardens and fruit trees are important for household food security. Farmers in Mafoota are successfully producing vegetables for the Sandals Resort, and a farmers' group at Cacoon Castle is working to supply the Round Hill Hotel. The Rural Agricultural Development Authority (RADA) and the R2RW Project are helping farmers produce Scotch bonnet peppers for the export market and will distribute disease-resistant plantain and bananas.

Environmental concerns related to agriculture in the GRW include the following:

- Most small farms are situated on hillsides, which in some cases are very steep. These sloping fields are very prone to soil erosion if they are clean-weeded and the soil is left bare, as is the case in the pineapple fields in Pisgah. This is not a widespread problem in the GRW.

- The improper use of agricultural chemicals, especially in close proximity to the river. An example is disposal of persistent organic pollutant pesticide-impregnated banana sleeve.⁹ The United Nations Environment Programme has declared this pollutant to be “the most dangerous pollutant released in the environment.”

Forestry. A substantial portion of the GRW has some type of forest cover, although all of it is secondary forest that was cleared or harvested in the past. Deforestation is not a serious problem in the GRW at present. The following vegetation types have been identified by the Forestry Department (FD) in the GRW:

- Lowland/submontane seasonal evergreen forest in a broad swath in the eastern and central parts of the watershed.
- Mixed seasonal evergreen and semi-deciduous forest in the north.
- Montane grassland in patches along the northern boundary.
- Mixed herbaceous shrublands, subsistence plantations, and grasslands in the central and southern parts.

Most of the forestland in the GRW is privately owned, although there are small blocks of forest estates at Cacoon Castle and Burnt Ground and at Jericho Forest Reserves. Another area at Copse was identified as a forest estate but has not been handed over to the FD. There is natural forest at Chesterfield being managed for protection.

Most forest harvesting is done selectively on private land by small loggers using portable saw mills or chainsaws. People also collect medicinal plants (roots) in the forest to sell. Most people switched from fuel wood to gas for cooking in the 1980s, taking pressure off the forest. The largest volume of wood currently harvested is used to produce charcoal for largely urban markets. This wood is harvested both legally and illegally.

The FD distributes seedlings from its nursery to landowners and provides technical advice on caring for them. Since hardwood species take 30 years to reach commercial maturity, most small farmers prefer to plant fruit trees, which begin to bear fruit in a few years and provide income over many years. The Plant-a-Tree Program under the R2RW Project is now distributing fruit timber tree seedlings to GRW households.

2.3.2 Commercial Activities

The few commercial activities in the GRW outside of agriculture are:

- Several quarries produce marl and other building materials.
- A juice and milk bottling plant at Cotton Grove.
- Several tourism businesses, including river rafting at Lethe and two tourist attractions based on the natural environment.
- A bottled-water plant at Blue Hole–Cool Runnings.

⁹Pesticides have not been found in the Great River water during recent sampling (Greenaway 2004).

3.0 WATERSHED MANAGEMENT ISSUES

A number of WM issues in the GRW need to be addressed in watershed planning. This section briefly describes these issues on the basis of background information provided in Section 2.0. The Action Plan in Section 5.0 contains actions to address these issues to the extent that it is financially and institutionally possible to do so over the five-year period of the plan. Many of the WM needs identified below require multiple responses such as awareness raising, technical assistance, enforcement, stewardship by communities, and better interagency coordination.

3.1 SOIL AND RIVER BANK EROSION, LANDSLIDES, AND SEDIMENTATION

The various forms of soil erosion, along with landslides and sedimentation, are natural processes in the GRW exacerbated by steep slopes, heavy rainfall, and erodible soils. In general, soil erosion is not a serious problem in the GRW. Poor land management can accelerate erosion processes, whereas good land husbandry can minimize erosion and landslides. Following are key WM activities:

- Identify and prioritize sediment sources and understand how sediment moves through the watershed.
- Positively influence land-use decisions and encourage good land husbandry.
- Ensure that infrastructure is built in a manner that minimizes landslides and erosion.

3.2 WATER POLLUTION FROM CHEMICALS AND DOMESTIC/AGRICULTURAL WASTE

The following categories of pollutants are found in the GRW:

- Biological, such as fecal coliform from human and livestock excreta. Coliform may originate from a point source, such as a malfunctioning septic system or a non-point source, such as a cattle pasture. Fecal coliform is the major water quality issue in the GRW (Greenaway 2004).
- Chemicals, primarily from fertilizers and pesticides, and usually from non-point sources such as agricultural fields, but in some cases from commercial facilities, such as petrol stations. These chemicals are currently undetectable in river water.
- Sediment, the movement of which is a natural ecosystem process and can only be considered a pollutant when moving in the river in excessive quantities, which happens during major rainfall events.

Ongoing water quality monitoring in the Great River system is being conducted by the NWC at their intake near the river mouth as well as at the sources of their smaller systems in the watershed (New Milns, Shelterwood, Mafoota River, Montpelier Spring, Seven Rivers, and Stonehenge). The NWC indicates that water quality in the Great River is reasonably good and on par with the quality of water from other rivers, as was verified by the UWI's recent sampling (Greenaway 2004). Water quality changes seasonally with flow patterns. Sediment increases during high-flow periods, especially during and after rains. Investigators from the UWI began a program of water quality sampling in 2002 at several places in the Great River drainage under the auspices of the R2RW Project and in collaboration with the SWB.

In general, water quality in the GRW is generally good, with the exception of fecal coliform concentrations. Following are key WM activities:

- Establish a long-term, low-cost water quality monitoring system.
- Reduce the use of agricultural chemicals and ensure that they are used properly.
- Ensure that human fecal waste is properly disposed of.
- Ensure that livestock do not graze in or near the river.
- Ensure that commercial facilities are properly sited and have proper waste treatment technology.

3.3 SOCIOECONOMIC TRENDS AND SUSTAINABLE DEVELOPMENT

It is highly likely that the GRW, especially in its lower sections, will become more heavily populated over the life of this Plan. The construction of Highway 2000 toward the end of the plan period will accelerate the development process. The current trend of watershed residents joining the urban work force is likely to continue, although it is anticipated that agriculture, forestry, and eco-heritage tourism will become more significant in the local economy.

Maintaining sustainable economic growth over the Plan period will be a challenge for GRW residents and government agencies at the national and Parish levels. Following are key activities needed to maintain the sustainability of economic development:

- Use the land-use planning and permitting processes in conjunction with the GRW Zoning Plan to guide development.
- Support residents to develop environmentally sustainable and financially rewarding livelihoods based on natural resources within the watershed.
- Encourage residents and communities to be watershed stewards through awareness, community institutions, and ongoing communication.
- Use enforcement measures when needed.

3.4 GOVERNANCE

Effective WM requires a supporting governance framework of laws and institutions that embraces all levels of government and communities. The legal framework for WM in Jamaica is currently being rationalized, and the roles of various government actors, especially the Parishes, are evolving. This uncertain situation has the following implications for WM in the GRW:

- WM institutions must be simple and robust to operate successfully in this uncertain environment.
- WM goals should be pursued to the extent possible through the existing procedures and programming of government agencies.
- Parish government should be integrated into the WM process.
- Residents and businesses should be encouraged to be self-policing to the extent possible.

3.5 GROUNDWATER QUALITY

Groundwater development is centered on the use of springs rather than by extraction through wells. The reason for this is that the geometry of the watershed does not allow for significant storage areas where successful wells can be sited.

The main factor that will need to be addressed in order to successfully conserve the present good quality of the watershed's groundwater is protection of the water quality of the watershed's springs. The important considerations in this regard are:

- Employment of good land husbandry practices throughout the watershed but especially in the upper zone. This is vital since the upper zone has an efficient drainage pattern and there is consequently a short residence time before rainwater gets to the springs—even in the middle watershed.
- Maintenance of the natural drainage in the middle watershed zone. This is essential because of the propensity for flooding in this zone, where a reasonable high density of sinkholes provides ready channels to the groundwater reservoir.
- Employment of safe practices to dispose of human, and human-generated, wastes, farm waste, and chemicals used for farming. The thinness of the soils in the watershed does not provide a long residence time for contaminants to be adsorbed.
- Increasing advocacy for implementation of the provisions of the Water Resources Act regarding preparation of Water Quality Control Plan and Declaration of Water Quality Control Areas.

3.6 HAZARD POTENTIAL

The main hazards that frequently affect the natural environment, often with significant disruption of socioeconomic activities and with loss of life, are sediment movements and flooding.

Several factors need to be considered in the amelioration of damage attributable to flooding:

- Controlling the sediment load carried in streams and reduction of the conveyance capabilities of channels.
- Correction of deficiencies in the drainage system. This will need to consider:
 - Using sanitation practices that will not allow runoff to be mixed with effluent from latrines, septic tanks, and sewers.
 - Using a human fecal waste disposal system that will not allow harmful pathogens to spread.
- Making environmental impact assessments (EIAs) mandatory for all developments.
- Developing the framework for a hazard management plan for the watershed. This could be done in conjunction with the Hazard Mapping Project, planned as part of the UNDP-supported Strengthening Community Disaster Management Project.
- Set up community-responsive road maintenance and flood warning systems to enable communities to be self-reliant, since during flood events access is often impaired.
- Incorporation of a disaster management component in the environment program that is being implemented by the Schools Environment Programme. The 4H Club movement could be a good entry point for this.

4.0 INSTITUTIONS FOR IMPLEMENTATION

4.1 PLAN OWNERSHIP

The Plan is intended to be a catalyst for building a sense of shared purpose among the GRW Parish governments, state agencies, and community organizations involved in its implementation. This sense of shared purpose to improve conditions in the GRW is the primary incentive that stakeholders have to implement the Plan. There is currently no legal mandate in Jamaica to formulate WM plans, but this Plan will be submitted to the Board of Directors of the Natural Resources Conservation Authority (NRCA) for endorsement.

Institutional arrangements for WM do not currently have a strong legal basis in Jamaica. No government agency has the authority to direct other agencies to pursue WM goals, although NEPA does have an overall coordinating role. Local watershed management committees rely on voluntary membership and currently have no legally mandated role or authority. In the absence of a strong institutional structure, creating a sense of ownership is a critical prerequisite for successful implementation of this Plan. The GRWMC and the SWB must therefore facilitate collaboration and build consensus to generate a sense of ownership, commitment, and shared purpose among community groups, Parish governments, state agencies, NGOs, and the private sector. Gaining the support of Parish councilors and national Members of Parliament will raise the visibility of the Plan and encourage the commitment of government agencies.

4.2 INSTITUTIONAL ISSUES

Institutional arrangements are the most critical part of the Plan from the viewpoint of sustainability. The institutional structure to implement this Plan must be acceptable to all stakeholders and low cost in terms of funds and time if it is to survive beyond the R2RW Project. The structure must encourage participation by Parish government and communities as well as state agencies. The design of an institutional structure is constrained by the following factors:

- WM law and policy are being revised, and there are currently no guidelines on how institutions should be structured at the watershed level.
- Institutional capacity and authority at the Parish level are evolving, and the ability of the Parish Council to actively participate in WM is currently constrained by a lack of resources and the Council's unclear role in environmental management.
- PDCs are at an early stage of development, and their roles and capability are evolving.

There are three main issues to be considered in designing GRW institutional arrangements:

- The need to balance participation of Parish and community stakeholders with that of national-level agencies while maintaining technical competence.
- The need to maintain the momentum of the R2RW Project and achieve continuing results with routine state agency budgets.
- The need to involve state agencies and Parish governments from all four GRW Parishes.

The most fundamental institutional challenge is how to design a robust institutional structure to accomplish core WM functions on a sustainable basis. The functions that must be institutionally sustainable into the future are the following:

- Facilitation of communications among stakeholders.
- Advocacy directed at government agencies.
- Awareness raising.
- Mobilization of communities and other stakeholders.
- Facilitation of a means for state agencies to orient their annual programming to support the objectives in this Plan in a way that complements the programming of other agencies.
- Facilitation of a means for the four GRW Parishes to collaborate on activities and land-use planning in the watershed.
- Implementation of a Monitoring Plan.
- Basic administrative functions, including record keeping and arranging meetings.

The following questions relate to designing an institutional structure to support these functions:

- Can all of these functions be achieved within one institution, or are two desirable?
- Should the composition of membership change over time as Parish governments gain more authority and resources?
- What external support will be needed to sustain the GRWMC in terms of training, equipment, and operational funds?
- What are the institutional implications if the GRWMC is given a legal mandate to advise national- or Parish-level officials?
- What is the optimal legal form of the GRWMC?

4.3 GREAT RIVER WATERSHED MANAGEMENT COMMITTEE

The authors of this Plan propose that the GRWMC be maintained as the sole non-governmental facilitating institution for WM in the GRW. The GRWMC will require technical support from SWB as well as minimal funding to cover administrative costs. The SWB should act as the secretariat for the GRWMC, housed in NEPA's Montego Bay office. The current system of having state agency officials in key leadership positions should be maintained in the near to midterm, with a shift toward a greater role for Parish government officials over time.

The proposed functional tasks of the GRWMC are the following:

- Establish and facilitate a Stakeholder Communications Network.
- Convene an annual Inter-Agency Consultative Group meeting.
- Convene quarterly inter-Parish coordination meetings.
- Work with the SWB to coordinate development of a watershed zoning plan with involvement of Parish planners.
- Raise awareness of watershed issues and mobilize communities in collaboration with SDC-CDOs.
- Advocate government interventions that will improve human and environmental conditions in the watershed.
- Work with the SWB to monitor implementation of the Plan.

There are two potential models for the structure of the GRWMC, depending on the roles that Local Watershed Management Committees are given in the revised Watershed Act:

1. The **Informal model**, in which the GRWMC adopts some form of legal status as a private voluntary organization but has no legally mandated authority.
2. The **Formal model**, which assumes that local WM committees will have legal status under the revised Watershed Management Act as well as a formal role that might include advising either Parish Councils or the Minister of Lands and Environment on watershed-related matters. The NIWMC may be designated to play a facilitative role in channeling information from the GRWMC.

The pace of decentralization and revised provisions of the Watershed Management Act will influence which model is chosen. A decision regarding the form and roles of the GRWMC should be taken during Year 1 of Plan implementation as discussed under Strategic Objective 7.

Another issue that should be clarified is the *scope of activities of the GRWMC*. Should it address only WM issues, or all environment and natural resource management issues in the GRW? If the latter option is chosen, the GRWMC could address issues such as forestry and biodiversity conservation, thereby avoiding the need to establish additional special-purpose committees.

The three functional tasks that are most critical for institutional sustainability are (1) the GRW Stakeholder Communications Network, (2) the Great River Inter-Agency Consultative Meeting, and (3) the Parish Coordination Committee. The roles and operations of these three bodies are described below.

The GRW Stakeholder Communications Network provides a communications medium for the following:

- State agency representatives.
- Parish-level elected officials and civil servants.
- PDCs.
- SDC-CDOs.
- CDC/CBOs.
- Residents and businesses.

The Communications Network would take over the communication role now played by R2RW. It could be established under the R2RW Project and later supported by the SWB. A part-time volunteer or paid staff member may be required to ensure the timely flow of information. Relationships among Communications Network members are strengthened by quarterly inter-Parish meetings and monthly Inter-agency coordination meetings held in each Parish. Fostering effective communication will require the use of multiple communication methods, including telephone, e-mail, meetings, and spreading the word verbally. The network will require some support from the SWB to get it started.

The annual GRW Interagency Consultative Meeting will provide a forum for state agencies to discuss their annual programming to ensure that they are providing complementary support to WM efforts in line with the GRW Action Plan. The meeting is held in the last quarter of each calendar year to discuss the following topics:

- Implementation of this Plan.
- Role of each agency in GRW tasks for the coming budget year.
- Lessons learned from implementation during the previous year.
- Monitoring results.

The primary output of these annual meetings is a commitment from each agency to include financial and human resources to implement GRW-related activities in their Annual Operations Plans and Three-Year Corporate Budgets. At least one additional meeting should be held during each year to discuss implementation issues. After each consultative meeting, the SWB will compile and distribute a synopsis of planned activities for the coming year. SWB will communicate with agency and GRWMC representatives throughout the year to ensure smooth implementation. Planners of each of the four GRW Parishes will be invited to the meetings to discuss land-use issues relevant to state agency programming.

The Inter-Parish Coordinating Committee provides a means for Parish governments to communicate about issues related to the GRW and to coordinate with each other regarding land-use issues. The committee also serves as a mechanism to engage and maintain communication with mayors and councilors to get them to support this Plan by passing a resolution endorsing it. Secretary/Managers should be invited to committee meetings because of their roles in setting the agenda of Parish council meetings and allocating resources to the Planning Department. Parish planners should be the primary technical point of contact at the Parish level because of their role in land-use planning and permitting.

4.4 STAKEHOLDERS

4.4.1 Facilitating Agencies

The SWB of NEPA is the facilitating state agency for implementing this Plan and plays a proactive role in building consensus for action. The SWB has several specific roles:

- Acts as the GRWMC secretariat and supports its operation through its Montego Bay staff.
- Provides WM technical advice to GRW stakeholders.
- Facilitates awareness activities.
- Implements a Monitoring Plan.
- Identifies additional watershed issues that should be addressed in the GRW and revises the Plan accordingly.
- Maintains a database of biophysical and socioeconomic data on the GRW, including a geographic information system (GIS).

NEPA reviews permit and license applications and EIAs for larger construction and development activities. *NEPA Enforcement Officers* in the four GRW Parishes ensure compliance with environmental regulations in accordance with the GRW Zoning Plan.

National Integrated Watershed Management Council (NIWMC): The NIWMC, which is chaired by the Ministry of Land and Environment, has 18 members: 13 are from government agencies and 5 are from NGOs, the private sector, and the UWI. Its role with respect to management of the GRW is to coordinate the WM initiatives of its member agencies with programs in the GRW.

4.4.2 Parish Governments

Parish-level officials, especially planners, make land-use and zoning decisions that shape the patterns and quality of development of the GRW. *Mayors and councilors* are elected representatives and have the potential to take a leadership role in watershed stewardship. *Secretary/Managers* have an important role in assigning resources and setting agendas for council meetings. *Parish planners* will have a major role in developing and implementing the GRW Zoning Plan and are responsible for the permitting of residential construction. They also make recommendations to NEPA regarding subdivisions and commercial construction permits. Planners are being trained in physical and environmental planning, including GIS, and have access to IKONAS satellite images and digital maps to use as the basis for planning. *PDCs* are the advisory arm of the *Parish Councils*, but their role is evolving and their capability is being developed. Parishes are formulating Sustainable Development Plans that should incorporate the WM considerations contained in the GRW Zoning Plan.

4.4.3 Communities

Communities: *CDCs* are a logical point for communication with communities as well as the basis for organizing stewardship activities when they are established and operate effectively. *CBOs* such as church and youth groups have an important role in mobilizing support for watershed stewardship. Communities must be engaged through activities such as Green Village Contests and innovative awareness campaigns to identify problems and design solutions over which they feel a sense of ownership. Youths between the ages of 13 and 23 are an important target group because of their future role in the community. Stewardship leaders must be identified in each community and trained in WM. Funds should be leveraged from other projects for assistance with development activities.

4.4.4 State Agencies

Social Development Commission: SDC-CDOs provide a direct communication channel for watershed-related information to and from communities. CDOs can facilitate the formation of watershed stewardship groups in communities, identify needs through participatory methods, and facilitate awareness campaigns. Training of trainers support and a WM handbook for CDOs would make these officers more effective. St. James Parish has one Development Area in the GRW centered on Cambridge with two nodes, each served by a CDO.

Rural Agricultural Development Authority: RADA officers in the four GRW Parishes coordinate with each other and with the GRWMC to continue improvements in agricultural production and marketing begun under the R2RW Project. They offer advice and support to farmers on land husbandry and integrated pest management practices. The Agricultural Support Services Project (ASSP) is a source of technical support that can be accessed through RADA.

Forestry Department: The FD has a legal mandate to manage and protect forest reserves within the GRW in accordance with good watershed forestry practice. The FD also distributes seedlings to private landowners and can target these efforts toward steep slopes and erosion-prone soils. The FD should encourage commercial-scale forestry production in less sloping areas through the use of the low-impact harvesting techniques currently being used by small-scale loggers. The FD discourages cutting large areas of forest for charcoal production.

Ministry of Local Government, Youth, and Community Development (MLGYCD) provides support to Parishes to enhance their capacity to plan and implement social and environmental activities. The Parish Infrastructure Development Project is working to enhance the capacity of Parish planners and the ability of communities to participate in planning.

Water Resources Authority (WRA): The WRA maintains one water flow gauging station in the GRW at Lethe. Institutional responsibility for water quality monitoring is divided between NEPA and the WRA. The WRA has the capability to support measurement of suspended sediment in rivers and agrees to take over sediment monitoring in the Great River if a sampling system is adopted under the R2RW Project. The WRA will also participate in developing and implementing a cost-effective system for monitoring other parameters of water quality.

National Water Commission: The NWC withdraws water from the Great River to supply most of the demand in and around Montego Bay as well as to the communities in the GRW. The NWC is interested in maintaining water quality in the Great River to reduce the cost of water treatment. The NWC monitors water quality at the intake near the mouth of the river and will continue to do so.

National Irrigation Commission: The NIC is currently active in Seven Rivers, where it is developing a 32-ha irrigation system whose ownership and management will be turned over to a Water User's Group consisting of farmers growing food crops aimed at the local market. NIC has an interest in the quality and quantity of Great River water, and will participate in the GRW Inter-Agency Consultative Group, participating in tasks within its area of expertise.

Public Health Department inspects sewage and wastewater disposal systems to identify those that are not designed or functioning properly. This is a key role, considering the current level of fecal coliform contamination.

Office of Disaster Preparedness and Emergency Management: Relevant elements of the Parish Disaster Management Plan should be integrated into the GRW Zoning Plan to restrict development in areas of flood or landslide hazard.

National Solid Waste Management Authority is responsible for solid waste disposal, including in rural areas.

National Works Agency (NWA) designs and builds water control engineering works and roads.

4.4.5 NGOs and the Private Sector

Montego Bay Marine Park advises the GRWMC and NEPA on linkages between land-based activities and coastal ecosystems and assists with monitoring.

Jamaica Agricultural Society provides advocacy for agriculture in the GRW and can be a medium for delivering a land husbandry message to its members.

Tourism Product Development Company evaluates and provides technical advice on tourism activities, including rafting and the possible revival of the rail link from Montego Bay to Appleton via Catadupa.

Private sector firms in the GRW: (see section 2.3.2).

5.0 ACTION PLAN FOR THE GREAT RIVER WATERSHED

5.1 THE ACTION PLAN FRAMEWORK

The *Action Plan* portion of the Strategic Plan for Sustainable Development of the Great River Watershed covers the five-year period (January 2004–December 2008). The Action Plan is built around a framework that links specific actions to strategic objectives and WM goals. The Action Plan employs various planning, technical, and institutional tools to guide and help watershed residents and land owners take actions and adopt behaviors that contribute to achieving strategic objectives, desired outcomes, and, ultimately, WM goals.

The *three goals* for GRW management stated below follow the themes of IWM: environmental protection, economic development, and stakeholder participation. *Strategic guidelines* provide direction in developing management procedures and allocating resources. *The communication and consultation mechanisms and stakeholder roles* described in Section 4.0 provide the means to implement this Action Plan.

Seven *strategic objectives* contribute to achieving the three WM goals (see Table 6, below). The objectives are achieved through specific *actions*.

Outputs are produced by one or more stakeholders to accomplish each action. Outputs should be planned in detail on an annual basis either in the operational plans of government agencies or through annual plans of the GRWMC. SWB and the GRWMC must build consensus to ensure that the parties contributing to the accomplishment of an output are working in a complementary manner. Some tasks may require more than one year to accomplish, or may even be continuous over the life of the Plan.

Progress toward implementing this Plan is judged on the basis of systematic *monitoring*. Monitoring *outputs* indicates the extent to which they have been produced as planned. *Outcome* indicators measure the degree to which outcomes, such as better water quality, are actually being achieved. Because this Plan is intended to be a living document, monitoring results should be used to revise the Action Plan to make implementation more effective and efficient in succeeding years.

GRW Zoning Plan. One of the key elements for success of WM in the GRW is the formulation of a Zoning Plan that divides the watershed into land-use categories on the basis of physical characteristics, particularly soil type, slope, and proximity to the river or its tributaries. Use restrictions must be developed to correspond with each land-use category. The process of developing the Zoning Plan is valuable because it requires Parish planners to work with planners from neighboring Parishes and with technical experts from state agencies to analyze the entire watershed and think about land comprehensively from a watershed perspective. The resulting Zoning Plan can then be used as a common basis for communication, planning, and permitting among Parishes and with other governmental agencies. Formulation of the GRW Zoning Plan is Action 2.2 of the Action Plan and should be undertaken as soon as possible after approval of the Strategic Plan.

5.2 WATERSHED VISION

Several vision statements for the future of the GRW were articulated at a Stakeholder Workshop held in June 2001 at the Knockalva Agricultural School and were confirmed in a more concise form at a strategic planning workshop held in Montego Bay in May 2003. The vision was stated as follows:

- Improved environmentally friendly technologies for watershed communities.
- Improved agricultural, forestry, and marketing technologies, including the Great River Brand.
- Watershed residents benefit from coordinated, integrated institutions.
- Environmental awareness and community actions through CBOs—watchdogs, guardians, and stewards actively involved in environmental activities.
- Model of sustainable heritage and ecotourism.

The following *Watershed Vision* encompasses these statements and is articulated within the IWM paradigm:

Great River Watershed residents have access to sustainable and financially rewarding livelihoods and practice sound watershed stewardship with support from community and government institutions.

5.3 MANAGEMENT GOALS

The *three GRW Management Goals* encompass the three conceptual pillars of the IWM paradigm: environmental protection, sustainable economic development, and stakeholder participation:

1. Improve water quality and environmental conditions.
2. Improve the economic returns from sustainable natural resource use.
3. Actively involve communities, government agencies, and the private sector in WM.

5.4 STRATEGIC GUIDELINES

The following strategic guidelines provide a rationale for the selection of management objectives and supporting actions and also provide guidance for implementation.

Strategic Guidelines

- A. Minimize dependence on recurrent financial support and special WM institutions by (1) institutionalizing WM in the procedures, legal mandates, and corporate budgets of government agencies and (2) permanently changing the attitudes and behaviors of individuals, communities, and businesses.
- B. Integrate planning, implementation, stewardship, advocacy, and livelihood interventions at the community level through participatory methods and community stewardship leaders.
- C. Make interventions within the appropriate spatial unit: Awareness and stewardship in communities; zoning and water quality monitoring at the watershed level; and integration with land use and development planning, permitting, and enforcement at the Parish level.
- D. Use R2RW technical and financial resources to lay the foundation for sustainable WM.
- E. Consider gender, literacy levels, and socioeconomic status in planning and implementation.

Table 6. Strategic Objectives and Actions

<i>Objective 1: Develop a sound scientific basis for monitoring progress toward achieving watershed management goals.</i>				
RATIONALE	INDICATIVE OUTPUTS	RESPONSIBILITIES	RESOURCES NEEDED	TIMING
Action 1.1: Develop a system for monitoring sediment movement in the Great River System.				
Provides a means to monitor effects of changes in land uses and management practices. Ability to identify important sediment sources.	Sediment budget, monitoring plan, scheduled sampling	R2RW, WRA, SWB	TA (2 person months [PM]); periodic sampling costs	Begin Year 1
Action 1.2: Conduct low-cost water quality monitoring on a continuous basis.				
Provides a means to monitor biological and chemical pollutants. Ability to identify important point and non-point sources.	Monitoring plan, scheduled sampling, link results to sources, and share with GRWMC and communities	WRA, NRC, SWB	TA (1 PM); periodic sampling costs	Begin Year 1
Action 1.3: Conduct a rapid biodiversity assessment of the Great River and its tributaries to determine the health of the aquatic ecosystem and to identify bio-indicators to be monitored (i.e., fish/invertebrate populations, habitat, riparian condition).				
Provides a baseline of current conditions and to track river ecosystem health.	Biodiversity assessment, monitoring plan, scheduled sampling	R2RW, SWB	TA (1 PM); periodic sampling costs	Begin Year 1
Action 1.4: Monitor Great River sediment and pollutants in the coastal ecosystem on the basis of results of initial UWI sampling.				
Track coastal ecosystem health in relation to Great River discharge.	Monitor plan, scheduled sampling	R2RW, MBMP, NEPA	MBMP assistance with initial assessment and monitoring	Begin Year 1
Action 1.5: Expand on community Participatory Appraisal techniques used by SDC to establish baseline socioeconomic conditions.				
Provides a baseline of current conditions in GRW communities and a means to track changes through scheduled monitoring appraisals in the same communities (see Action 4.1).	Training of SDC trainers, appraisals in priority communities, monitoring plan, scheduled monitoring appraisals	SDC, SWB	TA (2 PM); time of SDC–CDOs	Begin Year 1
Action 1.6: Establish an electronic database of environmental and socioeconomic data that is linked to the national watershed GIS and accessible to Parish planners.				
Provides a means to monitor trends in data sets and assess linkages in categories of data over time.	Expand database already established by SWB	SWB, WRA, NWC, SDC, R2RW	No additional resources needed	Ongoing
<i>Objective 2: Reduce sediment and chemical/biological pollution in the Great River and coastal waters affected by its discharge.</i>				
Action 2.1: Map point and non-point sources of sediment, pollutants, and hazardous chemicals and monitor regularly.				
Provides objective basis to assess extent of pollution from different sources.	Establish fixed reference points. Allow longitudinal trend analysis of pollution.	Lead: WRA; Support: NWC, NEPA, R2RW	Personnel, transport, lab facilities, operating funds	Ongoing

Action 2.2: Develop a watershed-based Zoning Plan for the GRW with the involvement of national and Parish agency planners.				
This is a basic tool of watershed planning that stipulates land-use restrictions for zones that are defined based on physical parameters. The Zoning Plan brings land-use planning and development planning into one document. It will be an appendix to the Strategic Plan upon completion.	Zoning plan workshops; The Zoning Plan (map with supporting guidelines and instructions to planners	R2RW, NEPA, Min. of Local Government (MoLG), Parish planners	TA (2 PM); Development workshops	ASAP–high priority
Action 2.3: Apply GRW Zoning Plan restrictions and guidelines to the permitting processes.				
Ensures that the land-use guidelines in the Zoning Plan are integrated into the permit and license review processes implemented by NEPA and Parish planners.	Appropriately referenced (in permitting and licensing process). Zoning Plan; national and Parish planners trained to use the Zoning Plan.	NEPA, MoLG, Parishes	Training seminars	Year I
Action 2.4: Identify home, subdivisions, and public buildings that require improved sanitation; apply cost-effective solutions.				
Provides basis to determine possible sources that could add contaminants to the Great River.	Determination of waste treatment and disposal systems used by the different groups. Assessment of the appropriateness and effectiveness of systems used. Recommend appropriate systems.	WRA, NEPA, R2RW	Personnel, transport, lab facilities, operating funds	Ongoing
Action 2.5: Identify environmentally safe and cost-effective means to improve solid waste disposal.				
This is a proactive action to reduce extent of solid waste pollution of the Great River system.	Assess methods being used by different groups for solid waste disposal. Recommend appropriate systems.	Lead: NEPA; Support: NPM, WRA, R2RW	Personnel, transport, lab facilities, operating funds	Ongoing
Objective 3: Institutionalize WM in Parish governments and national agencies.				
Action 3.1: Assist Parish planners to obtain information, planning tools, and resources to integrate WM into permitting and land-use planning decisions.				
Parish planners are receiving training and tools that will allow them to play a more active role in land-use and environmental planning. Complementary training and information on WM will allow them to effectively use the GRW Zoning Plan in their work.	A chapter on WM in the Parish Planner's Handbook being prepared by the MoLG with help from NEPA. WM training for Parish planners. Relevant elements of the GRW zoning plan integrated into Parish Sustainable Development Plans.	SWB, MoLG, GRWMC, R2RW	TA (IPM); one or more training seminars.	Year I

Action 3.2: Develop the GRW Stakeholders Communication Network under the GRWMC.				
Effective communication among the stakeholders is a key prerequisite to sustainability of WM efforts. Communication is currently facilitated by R2RW, but should be shifted to the GRWMC.	An electronic bulletin board or website. Stakeholder mailing and telephone lists.	GRWMC, SWB, R2RW	Assistance from R2RW	Ongoing
Action 3.3: Bring watershed management issues into the mainstream of Parish government.				
Parish Councils have not been active participants in WM in the GRW. Their interest and support will provide grassroots political support to WM efforts.	Field trips and briefings for mayors, councilors, and secretary/managers; GRW appears on the agenda of Parish Council meetings.	SWB, MoLG, GRWMC, R2RW	Staff time and travel costs to visit Parish capitals.	Ongoing
Action 3.4: Develop mechanisms for collaboration among state agencies working on WM in the GRW.				
After the R2RW Project ends, state agencies will be primarily responsible for technical WM interventions. These interventions will be most effective if they support this Action Plan in a complementary manner and foster collaboration among agencies.	Annual meeting of the GRW Inter-Agency Consultative Group, facilitated by the GRWMC. GRW activities in annual work plans and three-year budgets of state agencies.	GRWMC, SWB	Staff time	Ongoing
<i>Objective 4: Encourage communities and residents to internalize attitudes and behavior that support WM.</i>				
Action 4.1: Use a Participatory Appraisal approach to learn about communities.				
Communities are the most critical level for achieving both the environmental and development goals of integrated WM. It is important to (1) establish a baseline of socioeconomic conditions, (2) identify needs and opportunities with respect to economic development and livelihoods, (3) identify environmental problems and solutions, and (4) identify individuals and CBOs to take leading stewardship roles. SDC already uses participatory methods to work with communities, and these could be built on to obtain the required information.	Training of SDC trainers; Handbook on WM for SDC–CDOs; Appraisals in priority communities; Report of findings with analysis of results and implications for WM.	SWB, SDC, R2RW	TA (2PM); Travel expenses	Year I
Action 4.2: Build watershed stewardship capacity and commitment in GRW communities.				
Changing attitudes and behaviors of residents and building commitment to WM at the community level has very long-term impact. Reaching young people through schools and 4H clubs ensures that this impact will continue into the next generation.	Training and field trips for community leaders. Visits between up- and downstream communities. Continuing awareness activities, especially targeted at young people. Involvement of groups with an economic stake in the river, such as raftsmen.	SWB, SDC, GRWMC, Min. of Education, 4H clubs, R2RW, RADA	Staff time; travel expenses	Ongoing

Action 4.3: Build communication channels with communities.				
Maintaining communication with communities is important but difficult because (1) there are so many of them, (2) there is typically no single point of contact, and (3) communication mediums are limited. SDC–CDOs can play an important role in channeling two-way communication because they work in the communities on a regular basis.	Institutional mechanism established to channel information through CDOs. Regular use of this mechanism.	GRWMC, SWB	Staff time	Ongoing
<i>Objective 5: Facilitate sustainable economic development in the GRW.</i>				
Action 5.1: Develop criteria to assess potential development interventions.				
Resources available to invest in economic development are limited and may decrease when R2RW ends. Proposed interventions should be judged on criteria related to WM value, overall socioeconomic benefit, financial viability, and demonstration effect.	Intervention criteria; Process for judging proposed interventions against these criteria. Identify funding sources.	SWB, RADA, GRWMC, R2RW	Staff time	Year 1
Action 5.2: Explore means to increase the role of tourism in the Great River economy.				
Tourism could play a larger role in the Great River economy. There is potential to expand it in the areas of ecotourism and heritage tourism.	Inventory of existing and potential tourism attractions. Tourism TA.	TPDCO, GRWMC	TA (2 weeks); staff time	Year 2
Action 5.3: Facilitate marketing of locally produced products.				
Marketing is a major constraint to improving the profitability of agriculture and other businesses in the GRW.	Montpelier Agricultural Fair used as a way to interest farmers in co-operative marketing. Great River Brand established and used by farmers and other types of businesses.	RADA, Jamaican Agriculture Society, R2RW	Staff time; publicity costs	Year 2
Action 5.4: Encourage landowners to grow trees for economic benefit and environmental protection.				
Planting trees does not require a major investment in cash or time but can provide substantial monetary benefits either through the sale of fruit or wood products. Trees by themselves do not reduce erosion, but they create a stable land use over time.	Seedlings distributed; Technical advice provided.	FD, RADA, R2RW	Staff time and travel costs; cost of producing seedlings	Ongoing
Action 5.5: Plan to avoid negative impacts of Highway 2000.				
Highway 2000 is a major transportation corridor linking Kingston with Montego Bay. It will pass through the GRW from south to north, and is likely to increase population density and change settlement patterns, thereby affecting WM in the GRW.	Analysis of EIA and relevant documents of project to identify likely impacts on GRW. Impacts that are identified used to guide land-use planning approaches in the Zoning Plan.	SWB, R2RW, NWA	Staff time	Year 2

<i>Objective 6: Develop a collaborative, advocacy-based approach to enforcement.</i>				
Action 6.1: Base enforcement on a collaborative effort among the GRWMC, communities, and government agencies.				
Enforcement will be more effective and efficient if it is a collaborative effort among enforcement agencies, the GRWMC, and communities.	Enforcement officials actively collaborate with communities.	NEPA, Health Department	Staff time	Ongoing
<i>Objective 7: Establish a sustainable role and configuration for the GRWMC by narrowing its focus and building its capacity.</i>				
Action 7.1: Sharpen the focus of the GRWMC to well-defined functions.				
The GRWMC now brings together all categories of stakeholders and is an important element of sustainable WM in the GRW. Its functions must be clearly defined to ensure that they can be maintained with minimal financial inputs. The GRWMC's core functions are communication facilitation, advocacy, stakeholder mobilization, and awareness.	A clear statement of GRWMC functions that will survive after the R2RW Project ends.	GRWMC Executive Committee, SWB	Staff time	Year 1
Action 7.2: Adopt a structure and legal form that are appropriate to support these functions.				
The structure and legal form of the GRWMC are key elements of its sustainability.	GRWMC structure reviewed and revised as needed. GRWMC established as a legal entity.	GRWMC Executive Committee, SWB	Staff time	Year 1
Action 7.3: Strengthen the capacity of the GRWMC to manage its operations, communicate with stakeholders, conduct awareness campaigns, and raise limited funds.				
The GRWMC is still a relatively new body and needs to be strengthened to support its current and planned functions.	Training provided to relevant staff in administration, awareness, and communications.	SWB, R2RW	Staff time; hiring of trainers	Ongoing
Action 7.4: Include membership from the Parish and community levels to include GRW interest groups such as raftsmen, farmers (large and small), and business owners.				
The GRWMC is more likely to be sustained if it is supported by persons with an economic stake in the watershed.	Businesses (bee and pepper farmers, ecotourism operators) helped to form groups/cooperatives. GRW on agenda of meetings of identified groups.	NUCS; PC political, administrative, & technical functionaries; SDC-CDOs.	Staff time; hiring of trainers	Year 1 Ongoing

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